Ontario

Apprenticeship
In-school Curriculum Standards

Automotive Service Technician

Level 1

310S

Ministry of Training, Colleges and Universities

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AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

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AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Introduction

This new curriculum standard for the Automotive Service Technician trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 5 reportable subjects. The Program Summary of Reportable Subjects chart summarizes the training hours for each reportable subject.

The curriculum identifies only the learning that takes place off-the-job. The in-school program focuses primarily on the theoretical knowledge and the essential skills required supporting the performance objectives of the Apprenticeship Training Standards. Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to ensure that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Automotive Service Technician

Level 1

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Program Summary of Reportable Subjects - Level 1

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
1	Work Practices	30	20	10
2	Engine Systems	36	22	14
3	Electrical / Electronic and Emissions Systems	96	64	32
4	Drive Train Systems	36	24	12
5	Suspension / Steering and Brake Systems	42	26	16
	Total	240	156	84

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Number: **S1221**

Reportable Subject: **WORK PRACTICES**

Duration: Total 30 hours Theory 20 hours Practical 10 hours

Prerequisites: None

1.1 Fasteners

Total 8 hours Theory 6 hours Practical 2 hours

1.2 Bearings, Seals and Sealants

Total 8 hours Theory 6 hours Practical 2 hours

1.3 Precision Measuring Tools

Total 6 hours Theory 4 hours Practical 2 hours

1.4 Oxyacetylene, Heating & Cutting

Total 4 hours Theory 2 hours Practical 2 hours

1.5 Hoists and Lifting Equipment

Total 2 hours Theory 0 hours Practical 2 hours

1.6 Applied Computer Skills

Total 2 hours Theory 2 hours Practical 0 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

1.1 Fasteners

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross-Reference to Training Standards: 5161, 62, 63, 64, 65, 66, 67, 68, 69, 5170, 71, 72, 73, 74

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to identify fastener characteristics, select proper application, install and removal fasteners according to accepted trade practices.

LEARNING OUTCOMES AND CONTENT

1.1.1 Explain the fundamental characteristics of fasteners and retention techniques.

- specifications created by Society of Automotive Engineers (SAE) standards
- specifications of International Organization of Standards (ISO)
- bolt strength
  - tensile
  - shear
- fastener grade, pitch, threads per inch, threads per millimeter
- fastener diameter, length, head size
- use of anti-seize application
- factors that affect torque
  - thread condition
  - lubrication
  - compatibility
  - temperature
  - fastener composition

1.1.2 Identify the construction, types, styles and application of the following fasteners.

- bolts / nuts
- screws
- studs
- locking devices
- pins
- rivets
- keys

1.1.2 Continued

- washers
- retaining rings
- helicoils, timeserts
- thread sealants

1.1.3 Describe fastener applications, retention techniques and metal working skills.

- thread lockers
- torque to yield fasteners
- torque effects of wet, dry and clean threads
- locking techniques
- drilling
- tapping
- hack sawing
- filing
- riveting

1.1.4 Perform the following metal working operations.

- verify thread strengths and torque requirements for wet and dry
- repair damaged threads
  - free seized threads, remove broken studs / cap screws
  - install helicoils and timeserts
  - apply thread locker and anti-seize
- perform metal working tasks related to
  - drilling
  - tapping
  - hack sawing
  - filing
  - riveting
- perform fastener tightening operations

1.2 Bearings, Seals and Sealants

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross-Reference to Training Standards: 5161, 66, 67, 69, 71

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to define the purpose, construction, application, inspect, diagnose, remove and install bearings, seals and sealants according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

1.2.1 Explain the following fundamentals.

- friction characteristics
- effects of temperature
- lubrication
- bearing loads
  - axial / radial
- pre-load and end play
- hydrodynamic suspension

1.2.2 Identify the purpose, construction and applications of bearings, seals and sealants.

- friction bearings
- anti-friction bearings
  - ball
  - roller
  - needle
- seals
  - dynamic
  - static
- sealants
  - anaerobic
  - non-anaerobic
  - gaskets
- specialty sealants

1.2.3 Describe cause of failure of bearings, seals and sealants.

- scoring / spalling
- clearance
- over-heating
- vibration
- lubrication

1.2.4 Perform bearing, seal and sealant removal, installation.

- remove / install bearings
  - friction
  - non-friction
- remove / install seals
  - static
  - dynamic
- remove / install sealants
- remove / install gaskets

1.3 Precision Measuring Tools

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross-Reference to Training Standards: 5161, 62, 63, 63, 65, 66, 67, 68, 69, 5170, 71, 72, 73, 74

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform precision measurements and to maintain, calibrate and properly store precision measuring instruments according to the equipment manufactures' guidelines.

LEARNING OUTCOMES AND CONTENT

1.3.1 Explain Unit conversions

- convert between metric and Imperial measurements including fractions.

1.3.2 Identify the construction, types and application of precision measuring tools.

- micrometers
  - inside
  - outside
  - depth
- small hole gauges
- calipers
- vernier calipers
- telescoping gauges
- straight edges
- dial indicators
- torque wrenches
- straight edges
- cylinder gauges

1.3.3 Describe measuring procedures using the following tools.

- micrometers
  - inside
  - outside
  - depth
- small hole gauges
- calipers
- vernier calipers

1.3.3 Continued

- telescoping gauges
- straight edges
- thickness gauges
- dial indicators
- straight edges
- cylinder gauges
- torque wrenches

1.3.4 Perform maintenance and calibration on precision measuring tools and perform precision measurements.

- describe maintenance / calibration procedure
  - storage
  - lubrication
  - adjustment / calibration
  - restoring critical surfaces
- perform measurement and clearance checks

1.4 Oxyacetylene, Heating & Cutting

Duration: Total 4 hours Theory 2 hours Practical 2 hours

Cross-Reference to Training Standards: 5174.03, 5168.03

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe the function, construction, applications of oxy-acetylene equipment and to demonstrate the safe use perform heating and cutting operations according to approved industry standards.

LEARNING OUTCOMES AND CONTENT

1.4.1 Explain the functions, construction, and applications of oxyacetylene welding equipment.

- tanks
- identification features
- pressure regulators
- manual valves
- gauges
- torch tips
- heating and cutting torches

1.4.2 Describe the safe use of oxy-acetylene equipment.

- personal safety equipment and clothing
- setup, inspection, ignition and shutdown sequence
- cylinder handling
- fire prevention

1.4.3 Perform heating and cutting procedures.

- heating / cutting seized fasteners / components
- heating / cutting damaged fasteners / components

1.5 Hoists and Lifting Equipment

Duration: Total 2 hours Theory 0 hours Practical 2 hours

Cross-Reference to Training Standards: 5160.06

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform safe vehicle hoisting and lifting according to the equipment manufacturers' recommendations and approved industry standards.

LEARNING OUTCOMES AND CONTENT

1.5.1 Explain safe practices for hoist and lifting equipment.

- use of safety stands, jacks
- vehicle placement and movement
- finding the lifting points
- equipment maintenance

1.5.2 Identify lifting and hoisting equipment.

- lifting capacities
- adaptors & extensions
- types of hoists and lifting equipment
- safety locks and releases

1.5.3 Perform lifting of vehicles using shop lifts and hoisting equipment.

- position vehicle / wheel chocks
- check overhead environment
- verify correct engagement of lift points
- verify balance
- verify correct use of safety lock

1.6 Applied Computer Skills

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross-Reference to Training Standards: 5160.05, 5163.08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform necessary trade related computer functions and access trade and service information using a PC and the Internet according to on the job requirements.

LEARNING OUTCOMES AND CONTENT

1.6.1 Perform the following functions on a Networked PC.

- access trade related information
- access internet
  - browsing
  - file download
- access Email
  - reading attachments
  - send / receive

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Number: **S1222**

Reportable Subject: **ENGINE SYSTEMS**

Duration: Total 36 hours Theory 22 hours Practical 14 hours

Prerequisites: None

2.1 Engine Fundamentals

Total 12 hours Theory 8 hours Practical 4 hours

2.2 Cylinder Block Assembly

Total 6 hours Theory 6 hours Practical 0 hours

2.3 Cylinder Block Applications

Total 12 hours Theory 4 hours Practical 8 hours

2.4 Crankshaft Assemblies

Total 6 hours Theory 4 hours Practical 2 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

2.1 Engine Fundamentals

Duration: Total 12 hours Theory 8 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.01, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operating characteristics of internal combustion engines and perform engine disassembly / re-assembly procedures according to accepted industry standards.

LEARNING OUTCOMES AND CONTENT

2.1.1 Define engine terminology.

- inertia
- force and energy
- torque
- bore
- stroke
- swept volume
- displacement
- clearance volume
- compression ratio
- compression pressure
- volumetric efficiency
- mechanical efficiency
- thermal efficiency
- power measurement
- mean effective pressure
- Boyle's Law, Charles' Law

2.1.2 Explain the principles of operation of internal combustion engines.

- four-stroke cycle gasoline
  - Otto cycle
  - Atkinson cycle
  - Miller cycle
- two-stroke cycle gasoline
- four-stroke diesel
- rotary

2.1.3 Perform applied calculations to verify engine performance measurements.

- swept volume
- piston displacement
- compression ratio
- compression pressure
- thermal efficiency
- power measurements

2.1.4 Perform recommended engine component identification.

- identify moving and stationary engine components
- identify proper disassembly / re-assembly sequence
- identify components requiring marking
- identify areas of components requiring measuring
- identify areas requiring lubrication on assembly
- identify torque requirements

2.2 Cylinder Block Assembly Theory

Duration: Total 6 Hours Theory 6 hours Practical 0 hours

Cross-Reference to Training Standards: 5161.11, 12

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the construction and operating principles of cylinder block assembly components according to manufacturers' design.

LEARNING OUTCOMES AND CONTENT

2.2.1 Explain the design of cylinder block and components.

- cylinder blocks
- cylinders and sleeves
  - wall finish
- pistons and related components
  - alignment
  - thrust offset
- connecting rods
- bearings

2.2.2 Describe the types and configurations of cylinder blocks and components.

- cylinder blocks – inline, rotary, opposed and V type
- cylinders and sleeves
  - wall finish
- pistons and related components
- connecting rods
- bearings

2.2.3 Describe the operations of cylinder block and components.

- cylinder blocks
- cylinders and sleeves
- wall finish
- pistons and related components
- connecting rods
- bearings

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

2.3 Cylinder Block Applications

Duration: Total 12 Hours Theory 4 hours Practical 8 hours

Cross-Reference to Training Standards: 5161.11, 12, 13

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform recommended inspection / testing of cylinder block and components and explain recommended rebuilding procedures according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

2.3.1 Perform recommended inspection / testing procedures on cylinder block and components and evaluate suitability for service.

- perform general cleaning procedures
  - solvents
  - equipment
- inspect carbon buildup on pistons
- inspect for cylinder ridge
- cylinder block dismantling / assembly procedures
- visual inspection of engine short block component assemblies
- perform measurements for:
  - cylinder wear
  - deck warpage
  - main bore alignment
  - piston wear/damage
  - connecting rod alignment

2.3.2 Describe recommended cylinder block rebuilding procedures.

- cylinder boring, honing and deglazing
- replacement of piston and piston pin
- inspect piston ring, replace and check end gap and side clearance
- inspect connecting rod
- line boring or honing
- deck resurfacing, cutters, grinders and sanders

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

2.4 Crankshaft Assemblies

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross-Reference to Training Standards: 5161.11, 12, 13

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability explain the operation of crankshafts and bearings and perform recommended inspection / measuring procedures according to manufacturers' design.

LEARNING OUTCOMES AND CONTENT

2.4.1 Explain the design and application of engine crankshafts and bearings.

- crankshafts
- engine bearings
- balance shafts
- torsional impulse neutralizers
- flywheels

2.4.2 Describe the principles of operation of engine crankshafts and bearings.

- crankshafts journals
- engine block bearings

2.4.3 Describe the procedures and equipment used for servicing engine crankshafts and bearings.

- inspection and reconditioning of the crankshaft
- inspection and fitting of the crankshaft bearings

2.4.4 Describe the effect of the following in relation to engine performance.

- piston speed and acceleration
- balance shafts and gears
- crankshaft counterweights
- number of engine cylinders
- flywheel design features
- intake and exhaust timing
- static and dynamic imbalance

2.4.5 Perform recommended inspection / measuring procedures on engine crankshaft and bearings.

- perform visual inspection
- measure crankshaft end play
- check journal wear
- measure bearing clearance
- check bearing wear
- check crankshaft warpage

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Number:	**S1223**
Reportable Subject:	**ELECTRICAL/ELECTRONIC AND EMISSION SYSTEMS**
Duration:	Total 96 hours Theory 64 hours Practical 32 hours
Prerequisites:	None

3.1 Electrical Fundamentals

Total 14 hours Theory 10 hours Practical 4 hours

3.2 Electrical/Electronic Diagnostic Test Equipment

Total 6 hours Theory 4 hours Practical 2 hour

3.3 Battery Fundamentals

Total 6 hours Theory 4 hours Practical 2 hours

3.4 Electrical Circuit Calculations

Total 10 hours Theory 6 hours Practical 4 hours

3.5 Applied Electrical Schematics

Total 8 hours Theory 4 hours Practical 4 hours

3.6 Circuit Repair and Protection Devices

Total 10 hours Theory 6 hours Practical 4 hours

3.7 Electromagnetic Devices Fundamentals

Total 8 hours Theory 4 hours Practical 4 hours

3.8 Electronic Fundamentals

Total 6 hours Theory 6 hours Practical 0 hours

3.9 Fuel System Fundamental

Total 8 hours Theory 4 hours Practical 4 hours

3.10 Intake and Exhaust System

Total 8 hours Theory 6 hours Practical 2 hours

3.11 Emission Control Systems

Total 8 hours Theory 6 hours Practical 2 hours

3.12 Hybrid Systems

Total 4 hours Theory 4 hours Practical 0 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

3.1 Electrical Fundamentals

Duration: Total 14 hours Theory 10 hours Practical 4 hours

Cross-Reference to Training Standards: 5162.01 - .09, 5164.01 - .07, 5174.01, 08 - .13

GENERAL LEARNING OUTCOME

Upon successful completion the apprentice will have the ability to explain the terminology, and principles of operation of electricity according to sound scientific principles.

LEARNING OUTCOMES AND CONTENT

3.1.1 Identify basic electrical terms.

- atomic structure
- conventional and electron theory
- A/C, D/C
- conductors, insulators & semi-conductors
- magnetism
- electromagnetism
- voltage
- resistance
- power
- current

3.1.2 Identify sources of electricity.

- heat
- pressure
- static
- chemical
- light
- magnetism

3.1.3 Explain the principles of Ohms' Law & Watts' Law.

3.1.4 Identify Systems International (S.I.) units of measurement.

- e.g. mega, kilo, milli, micro

3.1.5 Identify electrical circuit characteristics.

- series / parallel
- basic symbols

3.2 Electrical/Electronic Diagnostic Test Equipment

Duration: Total 6 hours Theory 4 hours Practical 2 hour

Cross-Reference to Training Standards: 5161.02, 05, 08, 11, 5162.02, 03, 04, 07, 5163.02, 05, 08, 11, 12, 13, 5164.02, 05, 5165.02,05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to select, measure and use various types of electrical test equipment according to manufacturers' instructions.

LEARNING OUTCOMES AND CONTENT

3.2.1 Explain the types of electrical test equipment.

- Digital Multimeter (DMM)
- inductive clamp

3.2.2 Explain equipment setup, calibration and techniques used to measure.

- voltage
- resistance
- amperage

3.2.3 Perform the following measurements using electrical test equipment.

- voltage
- resistance
- amperage
- continuity
- impedance
- induction

3.3 Battery Fundamentals

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross-Reference to Training Standards: 5161.02, 05, 08, 11, 5162.02, 03, 04, 07, 5163.02, 05, 08, 11, 12, 13, 5164.02, 05, 5165.02, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, construction, principles of operation, perform inspection and testing of batteries according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.3.1 Explain the purpose and principles of operations of batteries.

- battery chemical action during charging and discharging
- temperature effect on charging and internal resistance ratings

3.3.2 Explain the construction, types, styles and applications of batteries.

- lead acid
- low maintenance
- absorbed glass mat
- maintenance-free batteries

3.3.3 Explain battery ratings.

- hot cranking amps (HCA)
- amp-hour rating (AH)
- cranking amps (CA)
- reserve capacity (RC)
- cold cranking amps (CCA)

3.3.4 Describe precautions for servicing and charging.

- temperature adjustments
- conductance testing
- refractometer
- hydrometer

3.3.5 Perform inspect and testing on batteries.

- visually inspect
- test state-of-charge
- perform surface discharge
- perform load test
- perform parasitic draw

3.3.6 Perform assigned operations on batteries.

- clean battery and terminals
- charge
- activation
- removal and replacement

3.4 Electrical Circuit Calculations

Duration: Total 10 hours Theory 6 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.02, 05, 08, 11, 5162.02, 03, 04, 07, 5163.02, 05, 08, 11, 12, 13, 5164.02, 05, 5165.02, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform circuit calculations to verify Ohms' and Watts' Laws according to sound scientific principles.

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LEARNING OUTCOMES AND CONTENT

3.4.1 Perform circuit calculations to verify Ohms' and Watts' Laws.

- series circuits
- parallel circuits

3.4.2 Perform assigned testing to determine voltage, current and resistance for the following circuits.

- circuit board exercises
- vehicle electrical circuits
- perform comparisons between measured and calculated circuit performances

3.5 Applied Electrical Schematics

Duration: Total 8 hours Theory 4 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.02, 05, 08, 11, 5162.02, 03, 04, 07, 5163.02, 05, 08, 11, 12, 13, 5164.02, 05, 5165.02, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to demonstrate knowledge of wiring schematics, component identification and ability to trace electrical circuits according to accepted trade standards.

.

LEARNING OUTCOMES AND CONTENT

3.5.1 Explain the purpose and fundamentals of electrical wiring schematics.

- electrical symbols
- circuit identification methods
- colour codes
- circuit number codes gauge and metric wire sizes
- types of connectors

3.5.2 Explain the function, construction and styles of wiring diagrams.

- layout
- interpretation
- variations by different manufacturers

3.5.3 Locate electrical components and trace electrical circuits of vehicle systems.

- perform on-vehicle verification of wiring diagram circuits
- locate power sources and grounds

3.6 Circuit Repair and Protection Devices

Duration: Total 10 hours Theory 6 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.02, 05, 08, 11, 5162.02, 03, 04, 07, 5163.02, 05, 08, 11, 12, 13, 5164.02, 05 5165.02, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe the purpose, construction and principles of operations of circuit protection devices and perform circuit repairs according to accepted trade standards.

LEARNING OUTCOMES AND CONTENT

3.6.1 Explain the fundamentals of circuit repairs.

- open circuits
- short circuits
- grounds
- unintentional grounds
- high resistance connections
- temperature effects
- safety when repairing electrical circuits

3.6.2 Explain the construction and application of circuit repairs.

- wiring and terminals
- wire size
- terminal connectors
- soldering
- shielding
- twisted pairs

3.6.3 Explain the principles of operation of circuit protection devices.

- circuit protection devices
  - fuses
  - circuit breakers
  - fusible links

3.6.4 Perform circuit analysis to identify.

- shorts
- opens
- grounds
- unintentional grounds
- high resistance
- dynamic circuit testing and voltage drops

3.6.5 Perform circuit repairs on the following components.

- wiring and connectors
- weather proofing
- circuit protection
- fuses
- circuit breakers
- fusible links
- repair wiring
- clean
- splice
- crimp
- solder
- corrosion protection

3.6.6 Perform tests to verify the correct operation of the following circuit protection devices.

- fuses
- circuit breakers
- fusible links

3.7 Electromagnetic Device Fundamentals

Duration: Total 8 hours Theory 4 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.02, 05, 08, 11, 5162.02, 03, 04, 07, 5163.02, 05, 08, 11, 12, 13, 5164.02, 05, 5165.02, 05

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe the purpose, construction and principles of operations of electromagnetic devices according to sound scientific principles.

LEARNING OUTCOMES AND CONTENT

3.7.1 Explain the purpose and fundamentals of electromagnetic devices.

- magnetism
- electromagnetism
- current flow and magnetic fields applied to relays, solenoids and motors
- right and left-hand rules
- counter-electromotive force effect

3.7.2 Explain the construction, types and principles of operations of electromagnetic devices.

- voltage generation
  - alternators
  - generators
- electric motors
- solenoids
- relays
- coils
- stepper motors

3.7.3 Inspect, test and diagnose electromagnetic devices for proper performance.

- electric motors
- solenoids
- relays
- coils
- stepper motors

3.8 Electronic Fundamentals

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross-Reference to Training Standards: 5162.07, 5163.02, 05 08, 12, 5164.02, 5174.11

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, function, construction and applications of electronic devices according to sound scientific principles.

LEARNING OUTCOMES AND CONTENT

3.8.1 Explain the purpose, function, construction and application of electronic devices.

- power supplies
- voltage regulators
- voltage limiters
- resistors
  - fixed
  - variable
  - potentiometer
  - thermistors
  - capacitors
- semiconductor devices
- diodes
  - rectifying
  - zener
  - light emitting
  - photo

3.8.2 Specify the precautions necessary when working with electronic circuits and components.

- voltage spike
- static electricity buildup
- electrostatic discharge
- maintaining correct safe shielding and grounding

3.9 Fuel System Fundamentals

Duration: Total 8 hours Theory 4 hours Practical 4 hours

Cross-Reference to Training Standards: 5163.01, 02, 03, 04, 05, 5165.01, 02, 03, 04, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe the purpose, function and principles of operation of fuel system components according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.9.1 Explain the purpose and fundamentals of fuels.

- engine theory
- thermodynamics
- combustion ratios
- fuels chemistry

3.9.2 Describe the function, composition and properties of fuels.

- gasoline fuel
  - volatility
  - octane rating
  - additives
  - hydrocarbons
  - atomization heat energy / calorific value
- diesel fuel
  - volatility
  - cetane number
  - viscosity
  - additives
  - sulfur content, etc.
- alternate fuels
  - Ethanol, E10, E85, biodiesel
  - propane, natural gas and alcohol
  - boiling points
  - volatility
  - pressure requirements

3.9.3 Explain the combustion principles of fuels.

- oxidation reactions
- products of combustion
  - HC
  - CO
  - CO2
  - NOX
- air fuel ratios
- atomization / vaporization
- detonation
- pre-ignition

3.9.4 Locate and identify fuel delivery system components.

- tanks
- filters
- lines
- pumps
- pressure regulators
- injectors

3.10 Intake and Exhaust Systems

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross-Reference to Training Standards: 5174.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, construction, principles of operations and perform inspection / testing of intake & exhaust systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.10.1 Explain the purpose and fundamentals of intake and exhaust systems.

- volumetric efficiency
- scavenging
- manifold vacuum and exhaust back pressure
- ported vacuum
- thermal expansion and contraction
- Boyle's Law, Charles Law, and Bernoulli's Theorem

3.10.2 Explain the construction, types, operation, styles and application of intake and exhaust systems.

- air cleaners
- intake and exhaust manifolds
- exhaust pipes
- resonators and mufflers
- intake manifold heating

3.10.3 Inspect and test intake and exhaust systems.

- visually inspect intake and exhaust systems
  - restrictions
  - noise
  - leaks
- perform:
  - test exhaust back pressure
  - test intake manifold vacuum

3.11 Emission Control Systems

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross-Reference to Training Standards: 5174.08, 09, 10, 11, 12, 13

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the basic operation of emission control systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.11.1 Explain the basics of emission control systems.

- combustion of fuels
- combustion bi-products
- properties of carbon monoxide, hydrocarbons, oxides of nitrogen.
- photo-chemicals, smog, acid rain, greenhouse effect
- emission standards and model year compliance
- legal consequences of emission equipment tampering
- air / fuel ratio
- temperature of combustion
- thermal expansion and contraction

3.11.2 Explain the basic operation of the emission control components.

- evaporative emission systems
- exhaust gas re-circulation systems
- positive crankcase ventilation
- catalytic converters
- air injection systems

3.11.3 Locate and identify emission control system components.

- manifold heating devices
- evaporative emission systems
- exhaust gas re-circulation systems
- positive crankcase ventilation
- catalytic converters/air injection systems

3.12 Hybrid Systems

Duration: Total 4 hours Theory 4 hours Practical 0 hours

Cross-Reference to Training Standards: OA H-19.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, operation and safe working practices associated with hybrid vehicles according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

3.12.1 Explain the basic hybrid types.

- hybrid system types
  - Toyota - synergy system
  - Honda - Integrated Motor Assist (IMA)
  - General Motors / Saturn - Belt Alternator Starter (BAS)
  - General Motors / Chrysler / BMW - dual mode

3.12.2 Explanation and identification of hybrid systems.

- high voltage / intermediate voltage
- cooling
  - Internal Combustion Engine (I.C.E.)
  - Inverter
- braking
- accessory
- air conditioning

3.12.3 Explain safe hybrid working practices.

- high voltage / intermediate voltage
- personal safety
- area safety
- protective equipment
- meter requirements
- disconnect procedures
- driving the vehicle into or out of the shop
- lifting / hoisting
- pushing or moving a hybrid

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Number:	**S1224**		
Reportable Subject:	**DRIVE TRAIN SYSTEMS**		
Duration:	Total 36 hours	Theory 24 hours	Practical 12 hours
Prerequisites:	None		

4.1 Clutch Assemblies

Total 8 hours Theory 6 hours Practical 2 hours

4.2 Basic Gear Theory

Total 4 hours Theory 4 hours Practical 0 hours

4.3 Manual Transmission / Transaxle Fundamentals of Operation

Total 12 hours Theory 12 hours Practical 0 hours

4.4 Manual Transmission / Transaxle Service and Diagnosis

Total 12 hours Theory 2 hours Practical 10 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

4.1 Clutch Assemblies

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross-Reference to Training Standards: 5166.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to visually inspect, diagnose, troubleshoot and perform repairs on clutch systems and components according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

4.1.1 Explain the basic fundamentals of clutch assemblies.

- clamping force
- centrifugal force
- mechanical advantage
- hydraulic advantage
- static and sliding friction
- co-efficient of friction
- friction and heat
- inertia

4.1.2 Identify the specific components of dry disc clutch assemblies.

- dry disc clutch assemblies
- flywheel / ring gear
- pressure plate
- clutch friction disc and hub assembly
- input shaft
- pilot bearing / bushing
- release bearing
- mechanical release mechanisms
- hydraulic release mechanisms
- clutch housings
- clutch control systems
- safety switch

4.1.3 Describe the operation of clutches assemblies.

- disengagement and engagement
- single and dual disc clutches
- wave / cushion spring
- hub / torsional springs
- semi-centrifugal clutches
- flywheel / ring gear
- pressure plate
- power flow
- pilot bushing / bearing
- clutch control systems
- safety switch

4.1.3 Perform inspection, diagnostics and troubleshooting procedures on clutch assemblies.

- perform visual / functional inspection
  - fly wheel
  - ring gear
  - clutch disc
  - pressure plate
  - clutch and housing alignment
  - clutch control system
  - safety switch

4.1.4 Explain repair operations on clutch assemblies.

- familiarization with manufacturers' service procedures
- clutch adjustment
- clutch overhaul procedures
- machining practices
- failure analysis
- lubrication practices
- fluid levels
- verify the repair and operation

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

4.2 Basic Gear Theory

Duration Total 4 hours Theory 4 hours Practical 0 hours

Cross-Reference to Training Standards: 5166.01, 05 – 10, 5167.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain basic gear theory and operation according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

4.2.1 Explain the basic fundamentals of gears.

- mechanical advantage
- laws of levers as applied to gears
- torque vs speed
- input / output rotational speed
- gear ratios
- shafts, splines and gears

4.2.2 Identify the specific characteristics of gears.

- gear nomenclature
- gear types
- simple, compound, and idler gear trains
- gear ratio calculations
- shafts
- bearings and bushings
- spacers and thrust washers

4.2.3 Describe the operation of gears.

- gears
- timing
- shafts
- power flow
- thrust control
- bearings and bushings

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

4.3 Manual Transmission / Transaxle Fundamentals of Operation

Duration: Total 12 hours Theory 12 hours Practical 0 hours

Cross-Reference to Training Standards: 5166.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe the operation of manual transmissions / transaxles according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.3.1 Explain the basic fundamentals of manual transmissions / transaxles.

- purpose
- functions
- types
  - sliding selective
  - constant mesh
- applications

4.3.2 Identify the specific components of manual transmissions and transaxles.

- manual transmission / transaxle
  - case, shafts, gears, synchronizers,
  - bearings, bushings, thrust washers, shims, gaskets, seals
  - transaxle final drive
  - lubrication
- shift controls
  - direct, remote
  - shafts, cables, levers
  - detent, interlock mechanisms, shift blocks

4.3.3 Describe the operation of manual transmissions / transaxles.

- gear ratios
- power flows
- power flow variations
- synchronizer
- shift controls
- lubrication

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

4.4 Manual Transmission / Transaxle Service and Diagnosis

Duration: Total 12 hours Theory 2 hours Practical 10 hours

Cross-Reference to Training Standards: 5166.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, test, diagnose and repair manual transmission / transaxle according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

4.4.1 Perform inspection, testing, and diagnostic procedures on manual transmissions.

- identify component failures and causes
- check fluid level
- adjust linkage
- identify noise
- identify vibration

4.4.2 Perform service and repair procedures.

- describe procedures to remove and install a transmission / transaxle
- dismantle and assemble manual transmission / transaxle
- verify power flow through gears
- check end play / run-out
- verify shift controls
- perform torque procedures for re-assembly
- perform alignment requirement
- identify fluid / lubrication requirements
- verify the repair

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

Number:	**S1225**
Reportable Subject:	**SUSPENSION / STEERING AND BRAKE SYSTEMS**
Duration:	Total 42 hours Theory 26 hours Practical 16 hours
Prerequisites:	None

5.1 Suspension System Fundamentals and Design

Total 2 hours Theory 2 hours Practical 0 hours

5.2 Frame, Suspension and Steering Types

Total 9 hours Theory 9 hours Practical 0 hours

5.3 Steering and Suspension Principles of Operation

Total 6 hours Theory 6 hours Practical 0 hours

5.4 Suspension/Steering System Inspection and Testing

Total 7 hours Theory 1 hours Practical 6 hours

5.5 Tires and Rims

Total 6 hours Theory 2 hours Practical 4 hours

5.6 Hydraulic Brakes Fundamentals

Total 12 hours Theory 6 hours Practical 6 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

5.1 Suspension System Fundamentals

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross reference to Training Standards: 5168.01, 02, 03, 04,

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the fundamental theories, characteristics and applications relative to suspension systems according to principles of physics.

LEARNING OUTCOMES AND CONTENT

5.1.1 Explain the fundamental theories of suspension systems.

- Hook's Law
- centre of gravity
- sprung / un-sprung weight

5.1.2 Explain characteristics and applications of suspension materials.

- spring steel
- tempered steel
- synthetic rubber
- fiber composites
- pneumatics
- hydraulics
- negative effects of heating suspension components

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

5.2 Frame, Suspension and Steering Types

Duration: Total 9 hours Theory 9 hours Practical 0 hours

Cross reference to Training Standards: 5168.01, 02, 03, 04, 5169.01, 02

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to identify and explain types, and the construction of frames, steering and suspension components according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

5.2.1 Identify various frame types and explain their construction and applications.

- frames and chassis types
- frame and chassis damage

5.2.2 Identify various suspension and steering types and components.

- non independent
- semi independent
- independent
- short- and long-control arms
- twin I beam
- McPherson strut
- modified strut
- wishbone
- multi link
- steering linkage types
  - parallelogram
  - cross steer
  - rack and pinion
  - haltenberger

5.2.3 Explain the application and construction of suspension and steering components.

- springs
- ball joints
- king pins
- strut bearings
- control arms and bushings
- radius rods
- strut rods
- stabilizer bars
- trailing arms wheel hubs
- wheel bearings
- shock absorbers
- steering linkages

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

5.3 Steering and Suspension Principles of Operation

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross reference to Training Standards: 5168.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operation of suspension and steering systems and components according to principles of physics.

LEARNING OUTCOMES AND CONTENT

5.3.1 Explain the operation of suspension and steering systems and components.

- non independent
- semi independent
- independent
- short- and long-control arms
- twin I beam
- McPherson strut
- modified strut
- strut bearings
- wishbone
- multi link- springs
- leaf
- torsion bars
- air springs
- ball joints
- control arms and bushings
- radius rods
- strut rods
- stabilizers
- trailing arms
- steering linkages
- shock absorbers

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

5.4 Suspension/Steering System Inspection and Testing

Duration: Total 7 hours Theory 1 hour Practical 6 hours

Cross reference to Training Standards: 5168.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to inspect and test suspension and steering systems and components according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.4.1 Inspect and test suspension and steering components.

- visual inspection
- dry park check
- measure trim height
- check for corrosion
- check for frame damage
- check springs
  - spring condition and deflection
  - effects of contamination on springs
- check shock absorbers
  - leaks
  - action
  - attachment
- perform suspension system inspection
  - control arm bushing
  - control arm sag
- check wheel bearings
  - preload
  - end-play
- check ball joints wear
- check king pins wear
- check steering linkages for wear and alignment

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

5.5 Tires and Rims

Duration: Total 6 hours Theory 2 hours Practical 4 hours

Cross reference to Training Standards: 5168.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain, test, repair and service tires and wheels in according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.5.1 Explain the purpose and fundamentals of tires and wheels.

- centrifugal force
- static friction
- kinetic friction
- torquing wheel nuts
- effects of water
- sliding and rolling friction
- sidewall markings
- static and dynamic balance
- nitrogen use

5.5.2 Explain the construction, types, and application of tires.

- wheels for cars and light trucks
- tire materials
- radial tire construction
- bias tire construction
- run flat tires
- tires, wheels
  - balancing
  - air pressure
  - tread design and traction

5.5.3 Perform tests and repairs on tire and wheels assemblies.

- visual inspection
- check tire matching for dual application
- check tire condition
  - wear
  - defects
- identify and measure radial and lateral wheel and tire run-out
- determine factors that affect tire wear
- determine factors that cause cord separation
- perform static and dynamic wheel balance
- perform tire repair
- check tire type mixing and application
- test wheel runout

5.5.4 Service tire pressure monitoring systems.

- reset, re-program and calibrate tire pressure monitoring systems

AUTOMOTIVE SERVICE TECHNICIAN – LEVEL 1

5.6 Hydraulic Brake Fundamentals

Duration: Total 12 hours Theory 6 hours Practical 6 hours

Cross reference to Training Standards: 5170.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain, identify, inspect and service brake systems and components in according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.6.1 Explain the fundamentals of braking systems.

- Pascal's Law
- laws of levers, mechanical advantages
- co-efficient of friction
- velocity and acceleration

5.6.2 Identify brake system components.

- brake fluid
- brake lines, hoses and fittings
- master / wheel cylinders
- calipers
- brake shoes and disc pads
- drums and disc
- hydraulic controls
    - metering valves
    - proportional valves
    - pressure differential valves
    - combination valves
- auxiliary mechanical brake assemblies

5.6.3 Explain the construction and operation of brake system components.

- master cylinder
- calipers

5.6.3 Continued

- wheel cylinders
- shoes and pads
- brake fluid
- hydraulic controls
- self-adjusting mechanisms
- drums and discs
- auxiliary mechanical brake assemblies

5.6.4 Inspect and service brake systems.

- check brake fluid
  - level
  - bleeding
  - flushing
  - condition
- check disc brakes
  - calipers function / leakage
  - hardware, guides
  - rotor measurements / thickness, runout
- check drum brakes
  - wheel cylinder function / leakage
  - hardware
  - back plate
  - self adjusters
  - drum measurements / diameter, out of round
- clean, lube and adjust
- adjust auxiliary mechanical brake assemblies

5.6.5 Perform steel brake line fabrication.

- bending
- flaring
  - ISO
  - double inverted flare